

United States Patent

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represented by the Secretary of the Navy

[56]

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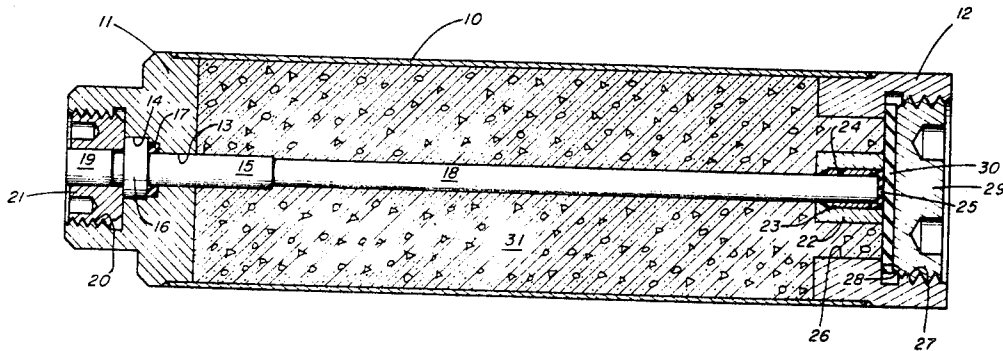
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[54] **PROPELLANT GAS GENERATOR**
5 Claims, 1 Drawing Fig.

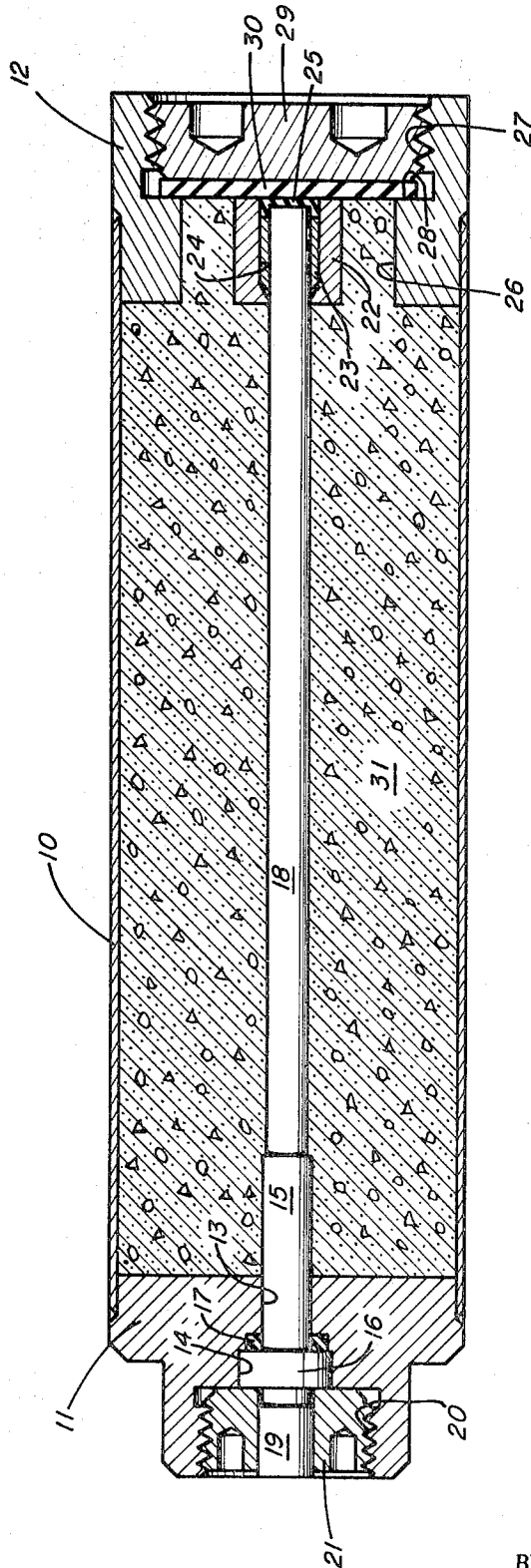
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ABSTRACT: An elongate substantially cylindrical-shaped housing substantially filled with a large volume of propellant and having disposed along the longitudinal axis thereof a fast burning, metal clad insensitive explosive line for initiating the propellant along the entire length of the longitudinal axial line in microsecond time.



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PROPELLANT GAS GENERATOR

BACKGROUND OF THE INVENTION

This invention relates generally to propellant gas generators and more particularly to an insensitive ignition line-type gas-generating device for producing maximum gas pressure uniformly along the entire length of the line.

The gas generator of the present invention is intended for use in a rocket-type missile for ejecting a payload of submissiles comprising the warhead thereof from the carrier rocket at a predetermined high velocity, but it is to be understood that it is equally applicable for use in other embodiments where it is desired to produce a large internal pressure.

Generally speaking, a gas generator is a device for performing mechanical work in a constrained system usually by the expansion of high-pressure gaseous products developed from propellants, explosives or pyrotechnic compositions. The term mechanical work is used herein in the classical sense of the integral of motion times the force applied along the direction of motion, the force being caused by gas pressure working on a deformable or movable surface.

Normally, a gas generator is initiated at a single point at one end thereof with a sensitive pyrotechnic or explosive material. Such primers direct hot fragments, gases and flames into the propellant material at the one end so that the burning time is a function of the linear burning rate of the propellant material and the length of the gas generator. In certain cases, where a relatively long combustion chamber is required by design limitations, the combustion reaction is propagated too slowly for peak gas pressure to be developed as rapidly as may be desired. Also, certain applications, as in the present case, require that the gas generator be disposed in the warhead section of the missile beyond the interrupter. Thus, presently available propellant ignition materials which use primary or other sensitive explosive materials are unsuitable for use therein as propellant igniters because they fail to meet minimum safety standards beyond the fuze train interrupter of a missile or the like.

Accordingly, in addition to overcoming the inadequacy of gas generators heretofore used to develop a given peak pressure rapidly enough to meet desired time limitations, the gas generator of the present invention must also be designed to be as insensitive as possible.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a gas generator for developing peak pressures with improved rapidity.

Another object of the present invention is to provide a gas generator ignition line for developing maximum gas pressure uniformly along the entire length thereof.

A further object of the present invention is to provide an insensitive propellant gas generator.

A still further object of the invention is to provide an insensitive gas generator for rapidly developing peak pressures which is simple in design, reliable in operation, and inexpensive to manufacture.

These and other objects are attained by an elongate cylindrical-shaped gas generator substantially filled with a large volume of propellant and having disposed along the central axis thereof a fast burning, metal clad, insensitive explosive line which may be initiated throughout its entire length in a microsecond range period of time. The burning time of the propellant thus becomes the time it takes to propagate through the radius of the cylindrical generator rather than through the length thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and many of the attendant advantages of the present invention will be readily appreciated as the same becomes understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein

the single FIGURE is a central longitudinal cross section of a preferred embodiment of the present invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawing, there is shown an elongated tubular shell 10 constructed of a very thin metallic material such as, for example, aluminum or a similar material suitable for the purpose. In practice, the thickness of the tubular shell 10 is on the order of 0.01 inches.

The tubular shell 10 is closed at one end by a generally cylindrical member 11 and at the other end by another generally cylindrical member 12. Portions of the end-closure members 11 and 12 fit snugly within the ends of the tubular shell 10 and the shell 10 is secured to the outer circumferential regions of the end closure members 11 and 12 extending beyond the ends of the shell 10 by welding or the like.

The cylindrical end-closure member 11 is provided with an axial bore 13 and a counterbore 14 in which a metallic ferrule 15 constructed of aluminum or a similar metallic material suitable for the purpose is positioned such that one end of the ferrule 15 protrudes into the tubular shell substantially along the longitudinal axis thereof. A substantially cylindrical flange 16 on the ferrule body 15 has approximately the same diameter as does the counterbore 14 and engages an O-ring sealing element 17 disposed within the counterbore 14 between the flange 16 and a shoulder formed between the bore 13 and the counterbore 14. The metallic ferrule 15 is provided with a bore (not illustrated) of substantial length in one end thereof for receiving in tight fitting relation one end of an elongated metallic sheathing tube 18 containing an ignition line charge for the device. An end booster or electroresponsive detonating means 19 is positioned in a bore in the other end of the ferrule 15 in communication with the line charge 18. A second axial counterbore 20 in the end closure member 11 is of greater diameter than the counterbore 14 and is internally threaded for receiving a threaded clamping collar 21. The collar 21, when threadably engaged within the end closure member 11, abuts the flange 16 of the ferrule 15 thereby clamping the ferrule 15 in place and slightly compressing the O-ring 17 to provide an effective seal between the ferrule body 15 and the closure block 11.

The other end of the line charge tubular sheathing 18 is received in a sleeve 22 at the opposite end of the tubular shell 10, wherein it is secured by a small collar 23 wedged within a central bore 24 disposed in the opposite end of the sleeve 22. An adhesive 25 such as, for example, silicon rubber is disposed within the bore 24 of the sleeve 22 over the ends of the ignition line tube 18 and the collar 23. The sleeve 22 is centrally positioned in a bore 26 in one end of the end-closure member 12. An internally threaded counterbore 27 in the end-closure member 12 forms a shoulder 28 therein at the juncture with the bore 26 and receives a threaded plug 29 which, when properly threaded in place in the counterbore 27, engages and compresses a disc-shaped sealing element 30 of rubber or the like against the shoulder 28 and the sleeve 22, thereby securing the tubular line charge 18 in place axially disposed within the shell 10 between the plug 29 and the collar 21.

A propellant mixture 31 of small but substantially uniform particle size is packed about the metallic line charge tubing 18 to as nearly as possible fill the shell 10. The particular propellant may be selected according to the order of peak pressures it is desirable to obtain with a given size gas generator. A mixture found to be satisfactory for the purpose set forth herein is one composed of about 23.7 percent by weight of boron, about 70.7 percent by weight of potassium nitrate and about 5.6 percent by weight of binders.

The line charge 18 must be an insensitive heat resistant explosive material having a fast burning characteristic such that the line charge 18 may be initiated throughout its entire length in microsecond time. Such a material is hexanitrostilbene, known as HNS. The preparation of HNS has been described in

the application of Kathryn G. Shipp, Ser. No. 365,572, filed May 5, 1964 and involves a one-step reaction which comprises the addition of a solution of 2,4,6-trinitrotoluene to an aqueous solution of an alkaline metal hypochlorite and then recovering the resulting product.

Another insensitive explosive material found to be satisfactory for use as a line charge 18 is a mixture composed of about 75 percent by weight of hexanitrostilbene (HNS), about 6 percent by weight of boron, about 17.6 percent by weight of potassium nitrate, and about 1.4 percent by weight of essential binders.

The operation of the device is readily apparent from the foregoing description. Upon actuation of the end booster 19, the metal clad HNS-line charge 18 is initiated throughout its entire length in microsecond time and the heat generated thereby melts away the sheathing thereon, whereby the propellant mixture 31 is initiated. The burning time of the propellant 31 thus becomes, as indicated hereinabove, the time it takes to propagate through the radius of the shell 10. The peak pressure developed within the shell 10 then bursts the thin-layered shell, releasing the gas generated therein.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. For example, the sleeve 22 may be integrally constructed with the end closure member 12, in which case one or more small bores therein might be substituted for the bore 26 for the purpose of loading the propellant. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A propellant gas generator comprising:
an elongated closed housing;

a line charge of explosive material sheathed within a metallic tubing and disposed axially within said housing substantially along the entire longitudinal axis thereof, said explosive line-charge material being a mixture comprising about 75 percent by weight of hexanitrostilbene, about 6 percent by weight of boron, about 17.6 percent by weight of potassium nitrate, and the remainder being essential binders,

a propellant packed about said line charge, and means at one end of said housing for initiating said line charge.

2. A propellant gas generator according to claim 1 wherein said propellant is a mixture comprising about 23.7 percent by weight of boron, about 70.7 percent by weight of potassium nitrate and about 5.6 percent by weight of binders.

3. A propellant gas generator according to claim 1 wherein said propellant is a mixture including boron and potassium nitrate.

4. A propellant gas generator according to claim 3 wherein said housing is substantially cylindrical-shaped and the walls thereof have a thickness of approximately 0.10 inches.

5. A propellant gas generator according to claim 4 wherein said housing and said line charge metallic tubing are constructed of aluminum.

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